positively identifying said target identity if, and only if, said discriminant analysis is satisfied for at least one of said enrolled persons optical tissue spectral data.

48. (Canceled)

REMARKS

In the Office Action dated September 18, 2002 (paper no. 14), all of the claims were rejected under 35 U.S.C. §102 and/or §103 in view of certain references cited either alone or in combination. Claim 48 has been canceled and Claims 1 – 3, 10, 12, 19 – 21, 33, 46, and 47 have been amended. The amendments correct certain antecedent bases and ensure that the following limitations exist in each of the claims: (1) that the spectral data used in the identifications or verifications are optical spectral data (*see, e.g.*, Application, p. 16, ll. 11 – 14); (2) that the identifications or verifications are made by comparing *spectral* distributions (*see, e.g.*, Application, p. 25, l. 16 – p. 27, l. 2); and (3) that this comparison use linear spectroscopic techniques. This linearity is recited in the form of computing a discriminant spectrum over a plurality of wavelengths, with the discriminant spectrum at each wavelength being derived from spectral data at that wavelength. Examples of such computations are provided in the application at p. 25, l. 16 – p. 26, l. 6.

As discussed below, this combination of limitations is not disclosed or suggested by the cited prior art.

A. Wunderman

Claims 10, 12, 15 – 18, 20, 33 – 39, 42 – 44, 47, and 48 stand rejected under 35 U.S.C. §102(e) as anticipated by U.S. Pat. No. 6,122,042 ("Wunderman"); Claims 1 – 3, 6 – 9, 19, 21 – 26, 29 –32, and 48 stand rejected under 35 U.S.C. §103(a) as unpatentable over Wunderman in view of U.S. Pat. No. 4,944,021 ("Hoshino"); Claim 28

stands rejected as unpatentable over Wunderman in view of Hoshino and U.S. Pat. No. 5,559,504 ("Itsumi"); Claim 40 stands rejected as unpatentable over Wunderman in view of U.S. Pat. No. 5,163,094 ("Prokoski"); and Claim 41 stands rejected as unpatentable over Wunderman in view of Itsumi.

Wunderman discloses a method of spectroscopy that is based on optical nonlinearities of a material (Wunderman, Col. 9, ll. 22 – 25) and suggests that such optical nonlinearities may be used as a means to identify individuals (*id.*, Col. 37, ll. 55 56). The nonlinear characteristics described by Wunderman are manifested by the fact that wavelength combinations are used to derive the nonlinearities:

> When a conventional single wavelength is applied to a material, its intensity must be sufficient to begin to "saturate" some occupied density of states at the energy. But since only a small non-linearity results from a large applied intensity, the non-linearity is thus difficult to resolve. However, when the detected interaction effects of two overlapping wavelengths (A and B) are measured, their algebraically, detected sum (A separate + B separate), and their combined superimposed sum (A + B, simultaneous) can readily be compared to say, 16-bit to 24-bit accuracy.
> (*Id.*, Col. 9, ll. 25 – 35).

These wavelength combinations are then achieved by illuminating combinations of light sources (*see generally, id.*, Col. 9, ll. 13 – 57), with Wunderman emphasizing that the use of wavelength combinations as part of its "IDEA" prode is "essential" to its disclosure:

> The IDEA probe can simultaneously apply any or all combinations of excitation wavelengths and search for nonsuperposition whenever the differente between the combined-applied detected signal and the separately applied agebraically summed signals does not equal zero.... The non-zero difference for the 32,767 comparisons thus provides a signature of that material. This measurement of optical non-linearity via a deviation from zero is a new and powerful form of spectroscopy that forms an essential feature of this invention.
> (*Id.*, Col. 10, l. 64 – Col. 11, l. 9).

In marked contrast, Applicants have identified that it is possible to derive sufficient identification information from spectral data with linear spectroscopic techniques, thereby avoiding the complexity advocated by Wunderman in deriving nonlinear characteristics. This is achieved by deriving a discriminant spectrum that, for each wavelength, is dependent only on spectral data *at that wavelength* (Application, p. 25, l. 16 – p. 26, l. 6). Thus, Wunderman fails to disclose the comparison of spectral data

as now recited in the claims. Indeed, with respect to the §103 rejections, Wunderman teaches away from the invention by suggesting that linear spectroscopic techniques are insufficient to perform the desired identifications ("Conventional spectrometers that measure spectral interactions using directional beams poorly accommodate spatial scattering properties of materials," *id.*, Col. 1, ll. 64 – 67, and "spectroscopic examination of materials … are often hampered by geometric effects of scattering over a broad range," *id.*, Col. 2, ll. 44 – 48).

This element of the claims is also not disclosed in any of Hoshino, Itsumi, and Prokoski. Accordingly, for at least these reasons, it is believed that the claims are patentable.

B. Stoianov

Claims 1, 21, and 46 stand rejected under 35 U.S.C. §102(b) as anticipated by U.S. Pat. No. 5,761,330 ("Stoianov").

Stoianov teaches the use of optical-digital hybrid techniques for automating fingerprint verification to identify an individual (Stoianov, Col. 1, ll. 6 – 9). In performing such identifications, Stoianov simply uses the well-known technique of comparing spatial fingerprint-pattern structures with a database of recorded fingerprint patterns (*id.*, Col. 5, ll. 27 – 39). As such, it is one of several examples of prior art that is limited to disclosing the use of *spatially* distributed characteristics for performing the identification of individuals. Common examples of the use of such spatially distributed characteristics include not only identifications made from spatial fingerprint distributions, but also from spatial distributions of vascular structure, spatial distributions of facial features, spatial distributions of bone structure, and the like.

This is in marked contrast to the pending claims, which now recite comparison of *spectral* distributions in making identifications. Rather than rely on discerning spatially distributed characteristics of an individual, Applicants have

recognized that it is instead possible to use the claimed methods and apparatus to perform identifications based on spectral distributions. For at least this reason, it is believed that the claims are patentable over Stoianov.

C. Toyoda

Claims 1, 21 – 25, and 46 stand rejected under 35 U.S.C. §102(e) as anticipated by U.S. Pat. No. 5,999,637 ("Toyoda")

Toyoda is also limited to disclosing identifications based on spatially distributed characteristics, and focuses particularly on the use of fingerprint identifications (Toyoda, Col. 4, ll. 63 – 66), as acknowledged in the Office Action.

Toyoda does not teach or suggest making identifications based on comparing optical spectral distributions of an individual's tissue as the claims now require. For at least this reason, it is believed that the claims are patentable over Toyoda.

D. Prokoski and Hoshino

Claims 1, 21, 27, and 46 stand rejected under 35 U.S.C. §103(a) over Prokoski in view of Hoshino.

Prokoski is a further example of prior art that teaches the use of spatially distributed characteristics to perform an identification. In this instance, it teaches the use of thermograms to identify individuals from biosensor data (Prokoski, Col. 3, ll. 19 – 23). Such thermograms reflect data related to the *spatial* structural configuration of blood vessels beneath skin, as well as spatial structural configurations of bone and cartilage structures. It is because of this focus on spatially derived structural identifications that Prokoski teaches identifying specific elemental shapes as providing a "signature" of an individual used in confirming identity (*id.*, Col. 3, ll. 38 – 42).

Neither Prokoski nor Hoshino teaches or suggests making identifications based on comparing optical spectral distributions of an individual's tissue as the claims now require. For at least this reason, it is believed that the claims are patentable over the combination of Prokoski and Hoshino.

E. Messerschmidt, Robinson, and Peterson

Claims 10, 12 – 14, 20, 33, and 47 stand rejected under 35 U.S.C. §103(a) as unpatentable over the combination of U.S. Pat. No. 5,655,630 ("Messerschmidt"), U.S. Pat. No. 4,975,581 ("Robinson"), and U.S. Pat. No. 6,330,346 ("Peterson"); and Claims 1, 3 – 5, 19, 21, and 46 stand rejected under 35 U.S.C. §103(a) as unpatentable over this combination further in view of Hoshino.

Messerschmidt is cited for its disclosure of obtaining spectral data from tissue and Peterson is cited for its use of spectral information in performing identifications (Office Action, p. 12). However, Applicants respectfully disagree with the assertion in the Office Action that Peterson teaches using the spectral information "in a manner very similar to that of Messerschmidt" (*id.*, p. 12).

In particular, Peterson is like some of the other prior art references discussed above in that its teachings are limited to the use of *spatially* distributed characteristics in performing identifications. This is evident not only from its reference to "illuminating subcutaneous structure and/or conditions" for comparison with stored indicia (Peterson, Col. 1, ll. 16 – 23), but also from the description of the device used:

> As seen in FIG. 1, a plurality of infrared light-emitting diodes are arranged, as is explained in detail hereinafter, such that they provide relatively even and continuous illumination of the object. The sensor array which is spaced by the mask and located beneath the field of view limiting holes assures that there is no cross-feed which might distort the image.
> (*Id.*, Col. 2, ll. 49 – 55).

The emphasis by Peterson on collection of an "image" and the need to avoid distortions by cross talk makes it clear that it is describing a method for illuminating subcutaneous

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tissue to collect spatially distributed structural information. There is nothing in Peterson that suggests the use of spectrally distributed characteristics in making identifications.

Applicants thus continue to traverse the assertion in the Office Action that there is a motivation to combine the teachings of Messerschmidt and Peterson. There is no suggestion in these references that it would be beneficial to use the spectral-distribution determinations of Messerschmidt with the spatial-distribution determinations of Peterson. Explained differently, Messerschmidt describes a *non-imaging* system that uses the measurement of multiple wavelengths of light as the input data to a spectrum analyzer (Messerschmidt, Figs. 1 and 2). In contrast, Peterson's system is an *imaging* system based on an array of source and detector elements (Peterson, Col. 2, l. 58 and Fig. 1).

Indeed, Applicants believe that at the time of their invention, it would not have been clear to one of skill in the art why or how an identification technique based on optical spectral distributions as embodied in the claims could work. For example, the specific illustration provided by Messerschmidt is concerned with using the spectrographic techniques for quantifying glucose levels in individuals (Messerschmidt, Col. 5, ll. 49 – 54). Knowing this glucose level is insufficient to distinguish large groups of individuals (and indeed seems better for grouping them rather than discriminating among them), particularly since glucose levels vary over time in response to metabolic functions. It was only the product of Applicants' insight that identified how optical spectral distributions could be used for identification purposes on an individual-by-individual basis and over time.

CONCLUSION

In view of the foregoing, Applicants believe all claims now pending in this Application are in condition for allowance and an action to that end is urged. If the

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Examiner believes a telephone conference would aid in the prosecution of this case in any way, please call the undersigned at 303-571-4000.

Respectfully submitted,

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APPENDIX: VERSION WITH MARKINGS TO SHOW CHANGES MADE

The changes made to the claims by the foregoing Amendment are highlighted by underlining added material and enclosing deleted material in square brackets.

Claim 48 has been canceled and Claims 1 – 3, 10, 12, 19 – 21, 33, 46, and 47 have been amended so that the pending claims read as follows:

1. (Amended) A system for verifying the purported identity of a targeted individual comprising:

an enrollment database including tissue optical spectral data collected from at least one enrolled persons, said enrolled persons tissue optical spectra data having a plurality of measurement values;

means for obtaining at least one tissue optical spectral data and purported identity from said target individual, said target individual's tissue optical spectral data having a plurality of measurement values;

means for comparing optical spectral distributions of said target individual tissue optical spectral data and said enrolled persons tissue optical spectral data, said enrolled person tissue optical spectral data corresponding to the purported identity of the target individual, said comparison providing a measure of the degree of similarity between said target individual tissue optical spectral data and said enrolled person's tissue optical spectral data, said comparison including:

computation of a discriminant spectrum over a plurality of wavelengths, wherein the discriminant spectrum at each wavelength is derived from said target individual tissue optical spectral data and said enrolled persons tissue optical spectral data at that wavelength; and

a determination whether the discriminant spectrum meets a calibration criterion; and

means for positively verifying said target individual's identity by confirming that said target individual's measure of spectral similarity is at least as similar as an established threshold value.

2. (Amended) The system as recited in claim 1, wherein said means for obtaining said target individual tissue optical spectral data includes means for measuring optical radiation reflected from sub-epidermal tissue of said target individual.

3. (Amended) The system as recited in claim 1, wherein said means for obtaining said target individual tissue optical spectral data includes a spectrometer.

4. (As Filed) The system as recited in claim 3, wherein said spectrometer is an FTIR spectrometer.

5. (As Filed) The system as recited in claim 3, wherein said spectrometer is a grating array spectrometer.

6. (As Filed) The system as recited in claim 1, wherein said optical spectral data include near-infrared wavelengths.

7. (As Filed) The system as recited in claim 1, wherein said optical spectral data include visible wavelengths.

8. (As Filed) The system as recited in claim 1, wherein said optical spectral data include near-ultraviolet wavelengths.

9. (As Filed) The system as recited in claim 1, wherein said comparison and similarity determination utilizes a classification algorithm.

10. (Twice Amended) A system for identifying a target individual comprising:

an enrollment database including tissue optical spectral data collected from one or more enrolled persons, said enrolled persons tissue optical spectral data having a plurality of measurement values;

means for obtaining at least one tissue optical spectral data from said target individual, wherein said means for obtaining said target individual tissue optical spectral data includes means for measuring optical radiation reflected from sub-epidermal tissue of said target individual, said target individual's tissue optical spectral data having a plurality of measurement values;

means for comparing optical spectral distributions said target individual tissue optical spectral data and said all enrolled persons tissue optical spectral data, said comparison providing a measure of the degree of similarity between said target individual's tissue optical spectral data and said enrolled persons tissue optical spectral data, said comparison including:

computation of a discriminant spectrum over a plurality of wavelengths, wherein the discriminant spectrum at each wavelength is derived from said target individual's tissue optical spectral data and said enrolled persons tissue optical spectral data at that wavelength; and

a determination whether the discriminant spectrum meets a calibration criterion; and

means for indicating identity as at least one of the said enrolled persons if the **[corresponding measure of degree of similarity is at least as similar as an established threshold value]** calibration criterion is met.

11. (Previously Canceled).

12. (Amended) The system as recited in claim 10, wherein said means for obtaining said target individual's tissue optical spectral data includes a spectrometer.

13. (As Filed) The system as recited in claim 12, wherein said spectrometer is an FTIR spectrometer.

14. (As Filed) The system as recited in claim 12, wherein said spectrometer is a grating array spectrometer.

15. (As Filed) The system as recited in claim 10, wherein said optical spectral data include near-infrared wavelengths.

16. (As Filed) The system as recited in claim 10, wherein said optical spectral data include visible wavelengths.

17. (As Filed) The system as recited in claim 10, wherein said optical spectral data include near-ultraviolet wavelengths.

18. (As Filed) The system as recited in claim 10, wherein said comparison and similarity determination utilizes a classification algorithm.

19. (Amended) A system for verifying the purported identity of a target individual comprising:

a computer including an input device and an output device;

an enrollment database including tissue optical spectra for at least one enrolled persons;

means for obtaining at least one tissue optical spectrum from said target individual, including an optical radiation source, an optical sampler for projecting optical radiation into the tissue and for collecting radiation that substantially passed through sub-epidermal tissue, an optical spectrometer for measuring the sub-epidermal optical intensity over a plurality of wavelengths;

means for obtaining said target individual's purported identity; and

a program running in said computer for comparing optical spectral distributions of said target individual tissue optical spectrum[a] and said enrolled persons tissue optical spectra corresponding to said target individual's purported identity, said comparing including:

computing a discriminant spectrum over a plurality of wavelengths, wherein the discriminant spectrum at each wavelength is derived from said target individual tissue optical spectrum and said enrolled persons tissue optical spectra at that wavelength; and

determining whether the discriminant spectrum meets a calibration criterion.

20. (Amended) A system for identifying a target individual comprising:

a computer including an input device and an output device;

an enrollment database including tissue optical spectra for at least one enrolled persons;

means for obtaining at least one tissue optical spectrum from said target individual, including an optical radiation source, an optical sampler for projecting optical radiation into the tissue and for collecting radiation that substantially passed through sub-epidermal tissue, an optical spectrometer for measuring the sub-epidermal optical intensity over a plurality of wavelengths; and

a program running in said computer for comparing optical spectral distributions of said target individual tissue optical spectrum**[a]** and all said enrolled persons tissue optical spectra by computing a discriminant spectrum over a plurality of wavelengths, wherein the discriminant spectrum at each wavelength is derived from said target individual tissue optical spectrum and said enrolled persons tissue optical spectra at that wavelength, and determining whether the discriminant spectrum meets a calibration criterion.

21. (Amended) A method for verifying the purported identity of a target individual utilizing an enrollment database including tissue optical spectra collected from a number of enrolled individuals having known identities, said tissue optical spectra **[spectral data]** having a plurality of measurement wavelengths, comprising the steps of:

obtaining optical target tissue spectral data from said target individual, said optical target tissue spectral data having a number of measurement wavelengths;

obtaining said purported identity from said target individual;

comparing optical spectral distributions of said optical target **[individual optical]** tissue spectral data and said enrolled person's tissue optical spectra**[l data]**, said enrolled person's tissue optical spectra corresponding to the purported identity of the target individual, said comparison providing a measure of the degree of similarity between said optical target **[optical]** tissue spectral data and said enrolled person's tissue optical spectra**[l data]** by computing a discriminant spectrum over a plurality of wavelengths, wherein the discriminant spectrum at each wavelength is derived from said optical target tissue spectral data and said enrolled person's tissue optical spectra; and

positively verifying said target individual's identity by **[confirming that said target individual's measure of spectral similarity is at least as similar as an established threshold value]** determining whether the discriminant spectrum meets a calibration criterion.

22. (As Filed) The method for verifying the identity of a target individual as recited in claim 21, wherein the method further includes a classification algorithm to perform said comparison between said target individual's optical spectral data and said enrolled person's optical spectral data.

23. (As Filed) The method for verifying the identity of a target individual as recited in claim 22, wherein the method further includes classification features that are determined from a set of calibration optical spectral data collected on at least one individual measured more than one time.

24. (As Filed) The method for verifying the identity of a target individual as recited in claim 23, wherein said classification features are applied to the said comparison between the target optical spectral data and the enrollment spectral data to determine the similarity with respect to the said classification features.

25. (As Filed) The method for verifying the identity of a target individual as recited in claim 24, wherein said verification occurs when said comparison of said target optical spectral data and said enrollment spectral data using said classification features is at least as good a predetermined measure of similarity.

26. (As Filed) The method for identifying a target individual as recited in claim 21, further comprising an enrollment database with optical spectral data collected from a number of enrolled individuals, wherein said number is greater than one.

27. (As Filed) The method for identifying a target individual as recited in claim 21, further comprising an enrollment database with optical spectral data collected from a number of enrolled individuals, wherein said number is equal to one.

28. (As Filed) The method for identifying a target individual as recited in claim 21, wherein said target spectrum is added to said enrollment optical spectral data after said verification of identity.

29. (As Filed) The method for identifying a target individual as recited in claim 21, wherein said tissue optical spectra include near-ultraviolet wavelengths.

30. (As Filed) The method for identifying a target individual as recited in claim 21, wherein said tissue optical spectra include visible wavelengths.

31. (As Filed) The method for identifying a target individual as recited in claim 21, wherein said tissue optical spectra include near-infrared wavelengths.

32. (As Filed) The method for identifying a target individual as recited in claim 21, wherein said tissue spectra includes a substantial spectra contribution from sub-epidermal tissue.

33. (Twice Amended) A method for identifying a target individual utilizing an enrollment database including tissue optical spectra collected from a number of enrolled **[individuals]** persons, said **[spectral data]** tissue optical spectra having a plurality of measurement wavelengths, comprising the steps of:

obtaining optical target tissue spectral data from said target individual[s], said optical target tissue **[optical]** spectral data having a number of measurement wavelengths**[, wherein said tissue spectra]** and including[e] a substantial spectral contribution from sub-epidermal tissue;

comparing optical spectral distributions of said optical target **[individual optical]** tissue spectral data and said enrolled person's tissue optical spectra **[spectral data]**, said comparison providing a measure of the degree of similarity between said optical target **[optical]** tissue spectral data and each of said enrolled person's tissue optical spectra **[spectral data]** by computing discriminant spectra over a plurality of wavelengths, wherein the discriminant spectra at each wavelength are derived from said optical target tissue spectral data and said each of said enrolled person's tissue optical spectra; and

positively establishing said target individual's identity by **[confirming that said target individual's measure of spectral similarity is at least as similar to one of the enrolled person's optical spectral data as an established threshold value]** confirming that at least one of the discriminant spectra meets a calibration criterion.

34. (As Filed) The method for identifying a target individual as recited in claim 33, wherein the method further includes a classification algorithm to perform said comparison between said target individual's optical spectral data and said enrolled persons optical spectral data.

35. (As Filed) The method for identifying a target individual as recited in claim 34, wherein the method further includes classification features that are determined from a set of calibration optical spectral data collected on at least one individual measured more than one time.

36. (As Filed) The method for identifying a target individual as recited in claim 35, wherein said classification features are applied to the said comparison between the target optical spectral data and the enrollment spectral data to determine the similarity with respect to the said classification features.

37. (As Filed) The method for identifying a target individual as recited in claim 36, wherein said identification occurs when said comparison of said target optical spectral data and said enrollment spectral data using said classification features is at least as similar as a predetermined measure of similarity for a number of enrolled persons optical spectral data.

38. (As Filed) The method for identifying a target individual as recited in claim 37, wherein the target identify is chosen as the most similar of all said enrolled persons whose enrollment spectral data are at least as similar to the said target spectral data as a predetermined measure of similarity.

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39. (As Filed) The method for identifying a target individual as recited in claim 33, further comprising an enrollment database with optical spectral data collected from a number of enrolled individuals, wherein said number is greater than one.

40. (As Filed) The method for identifying a target individual as recited in claim 33, further comprising an enrollment database with optical spectral data collected from a number of enrolled individuals, wherein said number is equal to one.

41. (As Filed) The method for identifying a target individual as recited in claim 33, wherein said target spectrum is added to said enrollment optical spectral data after said identification.

42. (As Filed) The method for identifying a target individual as recited in claim 33, wherein said tissue optical spectra include near-ultraviolet wavelengths.

43. (As Filed) The method for identifying a target individual as recited in claim 33, wherein said tissue optical spectra include visible wavelengths.

44. (As Filed) The method for identifying a target individual as recited in claim 33, wherein said tissue optical spectra include near-infrared wavelengths.

45. (Previously Canceled).

46. (Amended) A method for verifying the identity of a target individual comprising the steps of:

obtaining a number of enrollment optical tissue spectra from a number of individuals, said enrollment <u>optical</u> tissue **[optical]** spectra having a plurality of measurement wavelengths, said enrolled <u>optical</u> tissue **[optical]** spectra corresponding to said enrolled individual's identities;

obtaining an optical target tissue spectrum from said target individual, said optical target tissue spectrum having a number of measurement wavelengths;

obtaining an identifier from said target individual**[s]**;

selecting said enrolled optical tissue spectra**[l data]** that corresponds to said target individual's identifier;

performing discriminant analysis on said optical target tissue spectrum and said selected enrolled optical tissue **[spectral data]** spectrum corresponding to said identifier by computing a discriminant spectrum over a plurality of wavelengths, wherein the discriminant spectrum at each wavelength is derived from said optical target tissue spectrum and said selected enrolled optical tissue spectrum; and

positively verifying said target identity if, and only if, said discriminant analysis is satisfied.

47. (Twice Amended) A method for identifying a target individual comprising the steps of:

obtaining a number of enrollment optical tissue spectra from a number of individuals, said enrollment optical tissue **[optical]** spectra having a plurality of measurement wavelengths;

obtaining an optical target tissue spectrum from said target individual, said optical target tissue spectrum having a number of measurement wavelengths, wherein said optical tissue spectra include a substantial spectral contribution from sub-epidermal tissue;

performing discriminant analysis on said optical target tissue spectrum and all of said enrollment**[ed]** optical tissue spectra**[l data]** by computing discriminant spectra over a plurality of wavelengths, wherein the discriminant spectra at each wavelength are derived from said optical target tissue spectrum and one of said selected enrollment optical tissue spectra; and

positively identifying said target identity if, and only if, said discriminant analysis is satisfied for at least one of said enrolled persons optical tissue spectral data.

48. (Canceled)